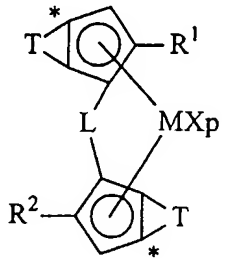
Claims

1. A multistage process comprising the following steps:

   a) polymerizing propylene and optionally one or more monomers selected from ethylene and alpha olefins of formula $CH_2=CHT^1$, wherein T^1 is a C_2-C_{20} alkyl radical in the presence of a catalysts system, supported on an inert carrier comprising:

   i) one or more metallocene compound of formula (I):



(I)

wherein:

M is an atom of a transition metal selected from those belonging to group 3, 4, 5, 6 or to the lanthanide or actinide groups in the Periodic Table of the Elements;

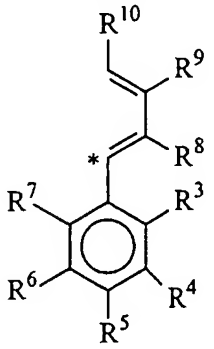
p is an integer from 0 to 3, being equal to the formal oxidation state of the metal M minus 2;

X, same or different, is a hydrogen atom, a halogen atom, or a R, OR, OSO_2CF_3, OCOR, SR, NR_2 or PR_2 group, wherein R is a linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl or C_7-C_{20} arylalkyl radical, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; or two X can optionally form a substituted or unsubstituted butadienyl radical or a OR'O group wherein R' is a divalent radical selected from C_1-C_{20} alkylidene, C_6-C_{40} arylidene, C_7-C_{40} alkylarylidene and C_7-C_{40} arylalkylidene radicals;

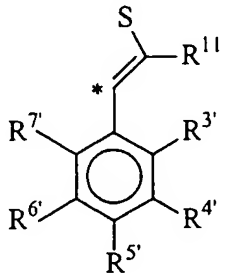
L is a divalent bridging group selected from C_1-C_{20} alkylidene, C_3-C_{20} cycloalkylidene, C_6-C_{20} arylidene, C_7-C_{20} alkylarylidene, or C_7-C_{20} arylalkylidene radicals optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements, and silylidene radical containing up to 5 silicon atoms;

R^1 and R^2, equal to or different from each other, are linear or branched, saturated or unsaturated C_1-C_{20}-alkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

T, equal to or different from each other, is a moiety of formula (IIa) or (IIb):



(IIa)



(IIb)

wherein:

the atom marked with the symbol * bonds the atom marked with the same symbol in the compound of formula (I);

R^3, R^4, R^5, R^6 and R^7, equal to or different from each other, are hydrogen atoms or linear or branched, saturated or unsaturated C_1-C_{40}-alkyl, C_3-C_{40}-cycloalkyl, C_6-C_{40}-aryl, C_7-C_{40}-alkylaryl, or C_7-C_{40}-arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; or two or more R^3, R^4, R^5, R^6 and R^7 can join to form a 4-7 saturated or unsaturated membered rings, said ring can bear C_1-C_{20} alkyl substituents; with the proviso that at least one among R^3, R^4, R^5, R^6 and R^7 is a linear or branched, saturated or unsaturated C_1-C_{40}-alkyl, C_3-C_{40}-cycloalkyl, C_6-C_{40}-aryl, C_7-C_{40}-alkylaryl, or C_7-C_{40}-arylalkyl radical optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

R^8, R^9 and R^{10}, equal to or different from each other, are hydrogen atoms or linear or branched, saturated or unsaturated C_1-C_{20}-alkyl, C_3-C_{20}-cycloalkyl, C_6-C_{20}-aryl, C_7-C_{20}-alkylaryl, or C_7-C_{20}-arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; or two or more R^8, R^9 and R^{10} can join to form a 4-7

saturated or unsaturated membered rings, said ring can bear one or more C_1-C_{10} alkyl substituents;

R^{11} is a hydrogen atom or a linear or branched, saturated or unsaturated C_1-C_{20}-alkyl, C_3-C_{20}-cycloalkyl, C_6-C_{20}-aryl, C_7-C_{20}-alkylaryl, or C_7-C_{20}-arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

$R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{6'}$ and $R^{7'}$ equal to or different from each other, are hydrogen atoms or linear or branched, saturated or unsaturated C_1-C_{40}-alkyl, C_3-C_{40}-cycloalkyl, C_6-C_{40}-aryl, C_7-C_{40}-alkylaryl, or C_7-C_{40}-arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; or two or more $R^{3'}$ $R^{4'}$ $R^{5'}$ $R^{6'}$and $R^{7'}$can join to form a 4-7 saturated or unsaturated membered rings, said ring can bear C_1-C_{10} alkyl substituents;

ii) an alumoxane or a compound capable of forming an alkyl metallocene cation;

b) contacting, under polymerization conditions, in a gas phase, ethylene with one or more alpha olefins of formula CH_2=CHT^1, wherein T^1 is a C_2-C_{20} alkyl radical, and optionally with a non-conjugated diene, in the presence of the polymer obtained in step a)

wherein the amount of the polymer obtained in step a) is higher than 4% and lower than 20% by weight of the polymer obtained in the whole process and the amount of polymer obtained in step b) is higher than 80% by weight and lower than 96% by weight of the polymer obtained in the whole process.

2. The process according to claim 1 wherein the catalyst system further comprises iii) an organo aluminum compound.

3. The process according to claims 1 or 2 wherein step b) is carried out in the presence of an additional organo aluminum compound.

4. The process according to anyone of claims 1-3 wherein in the compound of formula (I) M is titanium, zirconium or hafnium; p is 2; X is a hydrogen atom, a halogen atom or a R group wherein R is defined as in claim 1; L is selected from the group consisting of is $Si(CH_3)_2$, $SiPh_2$, SiPhMe, $SiMe(SiMe_3)$, CH_2, $(CH_2)_2$, $(CH_2)_3$ and $C(CH_3)_2$; and R^1 and R^2 are methyl or ethyl radicals.

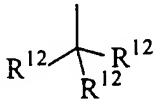
5. The process according to anyone of claims 1-4 wherein at least one among $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{6'}$ and $R^{7'}$ is a linear or branched, saturated or unsaturated C_1-C_{40}-alkyl,

C_3-C_{40}-cycloalkyl, C_6-C_{40}-aryl, C_7-C_{40}-alkylaryl, or C_7-C_{40}-arylalkyl radical, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements.

6. The process according to anyone of claims 1-5 wherein R^5 and $R^{5'}$, equal to or different from each other, are linear or branched, saturated or unsaturated C_1-C_{40}-alkyl, C_3-C_{40}-cycloalkyl, C_6-C_{40}-aryl, C_7-C_{40}-alkylaryl, or C_7-C_{40}-arylalkyl radicals, optionally containing one or more heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements.

7. The process according to claim 6 wherein R^5 and $R^{5'}$, equal to or different from each other, are branched C_1-C_{40}-alkyl radicals.

8. The process according to claim 7 wherein R^5 and $R^{5'}$ are groups of formula (III):



(III)

wherein R^{12}, equal to or different from each other, is a C_1-C_{10} alkyl radical.

9. The process according to anyone of claims 1 to 8 wherein in the compounds of formula (I) R^3, R^4, R^6, R^7, $R^{3'}$, $R^{4'}$, $R^{6'}$ and $R^{7'}$ are hydrogen atoms and R^{11} is a linear or branched, saturated C_1-C_{20}-alkyl.

10. The process according to anyone of claims 1 to 9 wherein in the compound of formula (I) T are the same and they have formula (IIa) wherein R^9 is a C_1-C_{20} alkyl radical.

11. The process according to anyone of claims 1 to 9 wherein in the compound of formula (I) T are the same and they have formula (IIb).

12. The process according to anyone of claims 1 to 9 wherein in the compound of formula (I) T are the same and they have formula (IIa) wherein R^9 is a hydrogen atom.

13. The process according to anyone of claims 1 to 9 wherein in the compound of formula (I) T are different and they have formulas (IIb) and (IIa).

14. The process according to anyone of claims 1 to 9 wherein in the compound of formula (I) T are the same and they have formula (IIb), wherein R^{11} is a linear or branched, saturated C_1-C_{20}-alkyl radical.

15. The process according to anyone of claims 1 to 14 wherein the inert carrier is a porous organic polymer.

16. The process according to anyone of claims 1 to 15 wherein step a) further comprises a prepolymerization step a-1) in which the catalyst system described in claim 1 is prepolymerized.
17. The process according to anyone of claims 1 to 16 wherein step a) is carried out in the presence of hydrogen.
18. The process according to anyone of claims 1 to 17 wherein step b) is carried out in the presence of hydrogen.
19. The process according to anyone of claims 1 to 18 wherein in step a) from 10% to 18% by weight of a propylene homopolymer or propylene copolymer containing up to 20% by mol of derived units of ethylene or one or more alpha olefins of formula $CH_2=CHT^1$ is produced.
20. The process according to anyone of claims 1 to 19 wherein in step b) from 82% to 90% by weight of an ethylene copolymer having from 3% by mol to 60% by mol of derived units of comonomers of formula $CH_2=CHT^1$ and optionally up to 20% of derived units of non conjugated diene, is produced.
21. The process according to anyone of claims 1 to 20 wherein in step a) a propylene homopolymer is produced.
22. The process according to anyone of claims 1 to 21 wherein in step b) an ethylene 1-butene copolymer having a 1-butene content ranging from 5% to 45% by mol is produced.